# Shapes and contours

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*Shape and contours: Optical vs. mechanical? A paradoxical concept.*

Shapes and contours are usually considered in their geometrical features. We can say that an object presents a spherical shape for example. This is equivalent to say that it presents a stable spherical contour that separates two parts of the space: the inner of the object and the external world. The object corresponds then to the stable experience of this inner part of the space.

Hence, the concept is related first to the spatial properties exhibited by an object. However, it can be extended to others correlated spatial properties, such as size, orientation, or texture considered as micro-local properties of the contour of an object. There are a lot of work addressing the question of the recognition of such parameters, the considered senses being the sight and the touch. It is often considered that except the texture, which is sensed equally by the touch and the vision, the others are more reliably encoded by the visual than by the haptic system [Klasky et al 1987]. Developmental psychology points out other results as those in very young infants, when transfers from touch to vision and not only from vision to touch are observed in the recognition of shapes (prism or cylinder): "*Results did not show transfer from vision to touch*" [Nadel, Steri, 2004].

Does that mean that there are two notions of shapes, one purely geometric, more related to vision, and another physical, more related to the resistance of matter, the texture being the frontier between the two spaces? Indeed, shapes have, as the Janus figure, two faces or two determinants. They emerge from two completely different processes, optical and mechanical, pointing out the underestimated ambiguity of the notion of shape.

In [Luciani, 2004], addressing the paradoxical ambivalence of the notion of shape, the author writes: "shape do not exist as single pattern affected to an object". Shapes have two faces, one looking to the physical materiality of the object, one looking to its optical property.

More generally, a single object can paradoxically exhibit several shapes, or several contours: the visual shape, along with several mechanical shapes.

More, the visual shape and the mechanical shapes of a single object have no reason to be always identical. Several situations illustrate this paradox. A rainbow, or the mirage of an oasis in the hot desert, have both a visual shape but do not have any mechanical contour. We can traverse them, or walk through them. Conversely, a perfectly transparent door has no visual contour, but has a hard mechanical shape.

Basically, the visual features are nothing else but the singularities of the interaction between photons and electromagnetic matter. The visual shape (the visually experienced flatness, the visually experienced spherical shape etc…) is the geometrical locus of the spatial singularities of the interaction between light and optical matter. Thus, visual events are intangible. Other classical examples could be geometrical drawing and synthetic 3D images produced by pure geometrical representations.

In usual rigid objects, the visual shape seen by the eyes is at the same spatial location as the mechanical shape "seen by the body". Although these objects are common, they are indeed very specific cases where the matter is 100% (99,99…%) mechanically rigid and simultaneously 100% (99,99…%) electromagnetically rigid (opaque).

But what about flames, rainbow, water, fluids, translucent pastes, glasses etc?

Furthermore, what about objects like cat fur or hair, that are not 100% (99,99%) mechanically rigid, and thus exhibit several mechanical contours?

For example, in the experience of touching a cat, we distinguish several types of contours; a penetrable zone (the fur of the cat), that we feel very smooth when we caress it or in which our hand can penetrate: then a deformable contour (the skin) when we press a little more; and finally a rigid contour, when we press stronger, and when we feel for example the very thin and rigid bones of the chin of the cat.

If you put a force sensor on the palm of the hand when stroking your cat, the force detected will be very low when the hand is in the fur, higher when it is on the deformable skin and higher when it is touching the skeleton. This means that a single entity - your preferred pet - may exhibit several mechanical contours, described by several thresholds in the singularities of the physical interaction.

When doing this strange experiment to press strongly a cubic piece of ice within your hand (and try to avoid the coldness to focus on the shape), you will feel simultaneously a very rigid (for example cubic) contour with very precise shape, and a kind-of-something-of-smooth (corresponding objectively to the very thin film of water which is between your skin and the piece of ice), and paradoxically a sort of deformable and penetrable object, as if your fingers seem to penetrate within the ice (due probably to the surfusion physical phenomenon).

In other words, and in a funny way, all what is happening in terms of contour as a primary cue of space organization, depends probably:

- on the percentage of the optical and of the mechanical rigidity;
- and on the intensity and the nature of the forces describing the mechanical interaction.

We can say that the optical contour is the experience of the singularities in the interaction between the light and the electro-optical matter, and the mechanical contours are the singularities in the interaction between the two mechanical bodies.

From this observation, it appears that the critical frontier in visual representation is not the distinction between morphology (shapes) and rendering (light) as usually considered in computer graphics, but between optical matter, represented by electromagnetic field, and mechanical matter represented through forces, in which the first produces pure visual features (color, shadows, etc.) and visual shape, and the second produces mechanical shapes and motions. Visual features are then related more to the geometry of the space, whereas mechanical shapes and motion have to be represented by dynamics.

One of the challenge - central for experimenting enaction and designing enactive interfaces – is that virtual realities and haptic interaction allow to experiment precisely the ambiguity of the notion of contours and shapes and their role in the constitution of the concept of object.

## References


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